Metamemory prediction accuracy for simple prospective and retrospective memory tasks in 5-year-old children

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Abstract

It is well documented that young children greatly overestimate their performance on tests of retrospective memory (RM) but the present investigation was the first to examine their prediction accuracy for prospective memory (PM). Three studies were conducted, each testing a different group of 5-year-olds. In Study 1 (*n*=46), participants were asked to predict their success in a simple event-based PM task (remembering to convey a message to a toy mole if they encountered a particular picture during a picture-naming activity). Before naming the pictures the children listened to either a reminder story or a neutral story. Results showed that children were highly accurate in their PM predictions (78% accuracy) and that the reminder story appeared to benefit PM only in children who predicted they would remember the PM response. In Study 2 (*n*=80), children showed high PM prediction accuracy (69%) regardless of whether the cue was specific or general, and despite typical over-optimism regarding their performance on a 10-item RM task using item-by-item prediction. Study 3 (*n*=35) showed that children were prone to over-estimate RM even when asked about their ability to recall a single item, the mole's unusual name. In light of these findings we consider possible reasons for children's impressive PM prediction accuracy, including the potential involvement of future thinking in performance predictions and PM.

KEYWORDS: children, prospective memory, retrospective memory, metamemory, future thinking

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The concept of metamemory was introduced to the literature by Flavell (1971), who argued that memory development during childhood is attributable largely to the development of knowledge about how memory works and the strategic application of such knowledge during memory tasks (declarative and procedural metamemory, respectively). *Declarative metamemory* reflects the understanding of person, task, and strategy variables affecting memory (reviews by Cavanaugh & Perlmutter, 1982; Weed, Ryan, & Day, 1990). In relation to memory for past information or retrospective memory (RM), one might know, for example, that remembering a long list of words is more difficult than remembering a short list of words (task variable), that adults typically outperform children on such tasks (person variable), or that rehearsing to-be-remembered items is better than simply looking at them (strategy variable). *Procedural metamemory,* on the other hand, reflects the ability to apply this declarative knowledge in the service of memory, as well as to monitor, regulate, and predict one's memory performance (Flavell, Miller, & Miller, 2002; Schneider & Lockl, 2008). For example, a child might expect to recall names of children from her current class but to forget the names of children from her kindergarten class attended few years ago.

A large body of research on metamemory development suggests that young children (aged 4-6 years) have fairly limited understanding of person, task and strategy variables affecting RM (Bjorklund, Dukes, & Brown, 2009; O'Sullivan, 1996; O'Sullivan, Howe, & Marche, 1996; Schneider & Pressley; 1997; Wellman, 1977). It has also been shown that the most striking developments in declarative metamemory take place between the ages of 4- and 8 years; by the time they reach third grade, most children have a reasonable grasp of factors influencing remembering (e.g., O'Sullivan et al., 1996). In addition, children with superior declarative metamemory perform better on RM tasks than children with inferior declarative metamemory (Flavell, 1971; Henry & Norman, 1996; Koriat, Goldsmith & Pansky, 2000; O'Sullivan, 1996; Schneider & Sodian, 1988; Short, Schatschneider, & Friebert, 1993; Schneider, 1998).

Limited knowledge about memory-related variables in younger children might explain their highly inflated view of their RM memory capacity. Typically, this is assessed by the study-predict-recall paradigm in which children are exposed to the to-be-recalled material (e.g., words, pictures, toys) and asked to predict how many they will be able to recall from memory, before actually recalling them. Although different amounts of study materials have been used (10, 15 or even 30 items), results invariably show that 4- to 6-year old children grossly overestimate the number of recalled items (Dunlosky & Metcalfe, 2009; Lipko, Dunlosky, Lipowski, & Merriman, 2012; Shin, Bjorklund, & Beck, 2007; Yussen & Levy, 1975). For example, in a study by Lipko, Dunlosky, and Merriman (2009), 4- and 5-year olds studied 10 pictures for 10 seconds, predicted how many they would recall, and then attempted to recall them. In total, there were five consecutive trials with different sets of pictures. Results showed that children repeatedly overestimated their performance across all five trials, even when they accurately assessed the small number of actually recalled items on a previous trial. These findings have been replicated recently by Lipowski, Merriman and Dunlosky (2013) who assessed children's predictions in a cued recall task on item-by-item bases, rather than asking them to make global predictions. Thus, 4- and 5-year old children were shown 12 animal toys one by one, and heard what their names were. Children had to recall the name of the toy and then were asked whether they thought they would be able to remember the name if they were questioned about it later. Predictions or judgements of learning (yes/no) were solicited either immediately or after a 2-minute delay. Results showed that children significantly overestimated their recall in both the immediate and delayed judgement of learning tasks (Experiment 1; no practice condition in Experiment 3), with particularly strong optimism in the immediate condition where 24 out of 29 children predicted that they would recall all 12 names.

Metamemory Regarding Prospective Memory

In contrast to RM, the topic of metamemory has hardly been studied in relation to prospective memory (PM), which involves remembering to carry out intended actions in future (e.g., keeping an appointment, posting a letter or taking a medication). Like adults, children have to carry out PM tasks on daily basis and frequent forgetting can be similarly disruptive for their everyday functioning (e.g., forgetting to take homework to school or passing on a message). Two early studies examined children's declarative metamemory for PM by questioning them about their understanding of reminders for PM tasks. First, Kreutzer, Leonard, and Flavell (1975) asked three age groups (4- to 5-year-olds, 6- to 7-year-olds, and 10- to 11-year-olds) to list every possible strategy they could think of to remember to take their skates to school the next morning, with answers being scored for references to internal strategies (e.g., mentally repeating the intention) versus various external strategies (e.g., placing the skates near the front door, writing a note). The results showed little in the way of developmental improvement, with children of all ages tending to focus on external strategies – despite the fact that the older children greatly surpassed the younger children in the number and sophistication of strategies they were able to suggest in response to questions about RM (e.g., how to remember an event from last Christmas). Second, Beal (1985) compared the ability of children (aged 5-, 6-, and 8 years) and young adults to choose between two potential reminder cues to assist performance on each of six different PM tasks. Similar to Kreutzer et al. (1975), there were no significant age differences in accuracy between the three groups of children. In addition, although 5- and 6-year-olds were reliably less accurate than the adults, the performance of the 8-year-olds matched the adults and was at ceiling level.

To date, there has been no research examining children's predictions regarding their PM accuracy. Moreover, the pattern emerging from the few available studies on adults is one of under-estimation of PM ability (Knight, Harnett, & Titov, 2005; Meeks, Hicks, & Marsh, 2007; Schnitzspahn, Zeintl, Jäger, & Kliegel, 2011; but see Devolder, Brigham, & Pressley, 1990). For example, in the Meeks et al. (2007) study, participants had to remember to press a key when seeing a particular target word during an ongoing lexical decision task. For half the participants the PM target word was a word depicting an animal, and for the remaining participants it was a syllable 'tor' in a word. After receiving PM instructions, participants had to predict what percentage of target words (0 to 100) they would be able to act upon in the lexical decision task. Following a 4-minute distracter task, all participants completed the lexical decision task and encountered eight PM targets. Results showed that participants in both conditions predicted to respond to about 50% of cues but their performance was significantly higher than 50%. In addition, while there was a small but significant correlation between PM predictions and actual performance in the animal target condition (r=.29, p<.05) the correlation in the syllable condition was not significant (*r*=.15, *p*>.05). These findings suggest that adults lack confidence in their PM. As speculated by Meeks et al. (2007), people might form an unfavourable opinion of their own PM capabilities due to frequent experience of PM lapses in everyday life.

The Present Investigation

Despite a long tradition of research into the development of metamemory skills surrounding retrospective remembering, we know little about children's metamemory regarding PM and nothing at all about their ability to predict their PM performance. The lack of information on the latter point is notable given that children's judgements about the reliability of their PM are likely to influence the extent to which they use external reminders and engage in elaborative planning of intended actions (as argued by Kliegel, Mackinlay, & Jäger, 2008). Given this gap in the literature, the present research sought to garner preliminary evidence on young children's predictions about their PM success. We conducted three studies, each testing a different group of 5-year-olds; Study 1 focused on PM prediction accuracy for a single PM task performed after a delay during a simple picture naming task, Study 2 compared prediction accuracy for PM and RM tasks, and Study 3 evaluated RM prediction accuracy using a single RM item analogous to the earlier PM tests.

We focused on 5-year-olds for two important reasons. First, the extensive evidence that children this age perform poorly on tests of RM prediction would suggest that children may similarly overestimate their PM performance. However, developmental research on PM has uncovered modest age-related variance in PM after the age of 5 years, leading to the claim that PM and RM constitute largely distinct capabilities with

PM maturing faster than RM (Kvavilashvili, Messer, & Ebdon, 2001; Kvavilashvili, Kyle, & Messer, 2008; Maylor & Logie, 2010). On this basis, it might be expected that PM prediction accuracy will be superior to RM prediction accuracy in 5-year-old children.

Second, evidence suggests that between 3- and 6 years of age children show striking improvements in their capacity for mental time travel, an ability that enables them to think about the future and consider hypothetical events (Suddendorf & Busby, 2005). Mental time travel is argued to involve self-reflective consciousness (*autonoetic consciousness*; Tulving, 2002), a form of consciousness that is believed to play an important role in memory (Koriat, 2007). Recently, some authors have suggested that the growth of self-reflective consciousness during early childhood might partly underpin the development of PM by enabling children to encode their PM intentions more efficiently (Atance & Jackson, 2009; Ford, Driscoll, Shum, & Macaulay, 2012). Specifically, the idea is that children will find it easier to form PM intentions if they mentally project themselves into the future and imagine themselves carrying out the intended response at the appropriate time (see Brewer & Marsh, 2010, for a similar proposal regarding adults' PM). This line of reasoning raises the possibility of substantial overlap between the cognitive processes involved in PM itself and the cognitive processes involved in PM performance predictions (which naturally pertain to the future), meaning that many 5-year-olds could show relatively good prediction accuracy for PM tasks. Moreover, prediction accuracy should be related to PM performance, such that children with superior PM are more likely to predict correctly than children with inferior PM. Accordingly, in Studies 1 and 2 we examined children's PM predictions as a function of

PM performance (pass vs. fail). We expected that children who passed the PM test would generally predict that they would be successful (i.e., good insight into own PM) whereas children who failed the PM test would *not* generally predict that they would be unsuccessful (i.e., poor insight into own PM).

An additional aim of Study 1 was to examine the effects of subtle reminders on PM performance. To this end, the delay interval between soliciting PM predictions and the onset of the PM task was filled by reading children either a neutral story ('Clumsy Alligator') or a reminder story ('Forgetful Spider') – with the latter story describing a character who suffered numerous examples of retrospective and prospective memory failures. We reasoned that such examples could act as cues for reminding children of their PM task. Since research on adults has shown that subtle cues enhance PM performance (Taylor, Marsh, Hicks & Hancock, 2004), we expected that the reminder story would improve children's PM accuracy in comparison to the neutral story. Moreover, if successful PM involves self-reflective consciousness, then children who predict remembering the PM task should benefit from the reminder story more than children who predict forgetting given their greater tendency for future thinking when making a prediction and, hence, their heightened sensitivity to performance-related cues.

Study 1

Method

Participants

A total of 51 children (25 boys, 26 girls) were recruited from three primary schools. All children were aged between 5 years 2 months and 5 years 8 months (*M* = 5 years 5 months), and spoke English as their primary language. Although the consent (in loco parentis) was granted by school headteachers, children's consent was also obtained. Children were randomly assigned to two conditions that varied in terms of which story was read to them prior to the PM task (reminder story vs. neutral story).

Materials

Fourteen line drawings of concrete nouns were taken from the Snodgrass and Vanderwart (1980) pool of line drawings. To ensure that 5-year old children had no problems naming them, each of the nouns chosen was within the early age-of-acquisition range (1.5 to 2.5 years), had almost 100% name agreement and high familiarity ratings in 5- to 6-year olds, using norms from Cycowiz, Friedman, Rothstein and Snodgrass (1997) and Morrison, Chappell, and Ellis (1997). The drawings were affixed to green square-shaped cardboard cards (12.5cm x 12.5cm). Four cards were used for a practice trial (flower, ladder, carrot, table) and the remaining 10 cards were used for the main picture-naming task (balloon, moon, key, brush, fork, tractor, umbrella, clock, cake, glasses). A PM target card depicted a picture of a tractor. Two stories - 'The Forgetful Spider' and 'The Clumsy Alligator' - were taken from the illustrated children's story book by June Woodman (1994). In the former, the spider not only forgets what he did a day before but forgets to pass on a message on four consecutive occasions. In the latter, the alligator repeatedly trips over or stamps on his friends and annoys everyone.

Procedure

Children were tested individually in a quiet room at their school. After initial greetings the researcher showed the child a toy mole, introduced as her friend 'Morris', which she positioned in the centre of the table. The child was told that the story book and picture cards on the table belonged to Morris, who allegedly could not see very well and needed the child's help. All children expressed willingness to help the mole. They were then informed that Morris wanted the researcher to read a story from the book and the child to name the pictures on the cards. The researcher demonstrated how to name the cards from the practice stack. This was done by holding up one card from the pile, naming it, and placing it down on the table. Each child was given a chance to name all four cards to ensure that they knew what they had to do and were praised once they finished the practice trial.

At this point the instructions for the PM task were introduced. Specifically, the researcher said: "Before naming the cards, I am going to read you and Morris a short story from this story book, would you like to hear the story?" After the child agreed, she continued: "Oh, I almost forgot to tell you that the mole is afraid of tractors. So, if you happen to see a picture of a tractor on any of these cards (*pointing to the stack of cards to be named later on*), could you please tell Morris not to be afraid of it as it is only a picture?" After the child answered affirmatively, the researcher asked: "Now, do you think you will remember to tell him this if you see a picture of a tractor or do you think you may forget?" The child was allowed to have a little time to consider this before the researcher recorded their prediction (will remember or forget). The researcher then presented the child with a confidence rating scale consisting of a horizontal line with three boxes underneath depicting the printed words 'very sure', 'sure' and 'not sure', and said: "Now, I want you to tell me how sure you are that you will remember (*or forget, if the child predicted forgetting*) to tell the mole not to be afraid. Look at this picture, this box means that you are very sure, this box means that you are just sure, and this box means that you are not sure at all. Now, how sure do you think you are?" Children had to point to the box and say their choice out loud, and the researcher recorded their response (*3=very sure*, *2=sure*, *and 1=not sure*).

After obtaining the confidence rating, the researcher read a story. Half the children heard 'The Forgetful Spider' story, which could potentially remind them of their PM task, and the other half heard 'The Clumsy Alligator' story that did not contain any references to forgetting. While reading the story, the researcher showed the child relevant illustrations from the book ensuring that they were fully engaged in the story. On finishing the story, which took around 5-7 minutes to narrate, the child was told that they now had to name the cards for Morris. No mention of the PM task was made at this stage. The order of card presentation was the same for each child and the target card with a picture of a tractor was always in the 6^{th} position in the stack. If the child took longer than five seconds to name a picture, the researcher named it herself and asked the child to continue. The researcher recorded whether the child remembered to re-assure the mole (i.e., telling him not to be afraid) when naming the target card with the tractor.

All children were praised when they finished naming the cards regardless of whether they remembered the PM task. However, those who forgot to carry out the PM task were given the following probe questions to determine whether their failure reflected a genuine PM lapse or, alternatively, inability to recall the PM instructions: (1) "Was there anything else you had to do when naming the pictures?"; (2) "Was there anything else you had to do when you saw a particular picture?"; (3) "Was there anything you had to do when you saw a picture of a tractor?" and (4) "Didn't you have to tell Morris not to be frightened when you saw a picture of a tractor?" If the child could not recall or recognize the PM task after this final probe, it was assumed that his/her failure was due to retrospective forgetting of instructions and his/her data were excluded from the analyses.

Results

Of 51 children, 27 (53%) did not remember the PM task (i.e., they forgot to tell Morris not to be afraid of the tractor). Post-experimental probing found that five children failed to recall the PM instructions even following the final and most specific prompt, indicating that they had no RM for the PM instructions. Therefore, the data of these five children were excluded and all the analyses reported below are based on 46 children. All parametric tests were conducted using a 2-tailed level of significance of $p<.05$ (marginal $p<.10$).

PM predictions and performance

The top panel of Table 1 (panel a) shows the number of children who remembered or forgot the PM response as a function of initial PM prediction (i.e., 'will remember' vs. 'will forget'). Of 28 children who predicted remembering, 21 (75%) did remember the PM task, but of 18 children who predicted forgetting only 3 (17%) remembered the task. The relation between children's predictions and their actual performance was reliable, $\chi^2(1, N=46)=14.94$, $p<.001$ (Phi Coefficient = .57). In other words, there were 36 children (78%) who made a correct prediction (either predicted remember and remembered or predicted forget and forgot), seven children (15%) who over-estimated their performance (by predicting remembering but forgetting the task), and only three children (7%) who under-estimated their performance (by predicting forgetting but actually remembering the PM task). A goodness-of-fit test showed that these percentages were significantly different from the expected percentages (50%, 25%, and 25%, respectively), had the children been making predictions at chance level $\chi^2(2, N=46)=15.39$, $p<.001$.

The middle and lower sections of Table 1 present the results separately for children who heard the neutral story (panel b) versus the reminder story (panel c). When considered individually, the relation between PM prediction and PM performance was reliable for both the neutral story condition, $\chi^2(1, N=23)=3.88$, $p=.049$ (Phi Coefficient = .41) and the reminder story condition, $\chi^2(1, N=23)=11.51$, $p=.001$ (Phi Coefficient = .71).

Further analyses examined whether PM prediction accuracy differed between children who remembered the PM task and those who forgot. Among the 24 children who enacted the PM response, 21 had predicted that they would succeed on the task (88%) and 3 had predicted that they would fail (12%). These percentages were significantly different from the expected percentages had the children been making predictions at random, $\chi^2(1, N=24)=13.50$, $p<.001$. In contrast, among those 22 children who forgot to enact the PM response, the percentages of children who predicted they would either fail (68%, $n=15$) or remember the PM task (32%, $n=7$) were only marginally different to chance, $\chi^2(1, N=22)=2.91$, $p=.088$. In addition, there was a trend in the predicted direction showing that the proportion of children who correctly forecast PM success was higher than the proportion of children who correctly forecast PM failure (.88 vs. .68), $z=1.65$, $p=.098$, 2-tailed.

Effects of story condition

To examine the effects of the stories on children's PM performance, we compared the proportion of children who remembered the task in the neutral story (.39) and reminder story (.65) conditions (see Table 1, panels b and c). Although the difference between these proportions was in the predicted direction (.65 vs. .39), z=1.77, p=.076, 2-tailed, the reminder story appeared to benefit only the children who expected to remember the PM task. Among the children who predicted remembering, the proportion that really did enact the PM response was marginally greater in the reminder story condition than in the neutral story condition (.88 vs. .58), z=1.76, p=.078, 2-tailed. Among the children who forecast they would fail, the success rate was equivalent for the reminder- versus neutral story conditions (.14 vs. .18), z=0.22, p=.826, 2-tailed.

PM confidence ratings

Table 2 shows the equivalent breakdown of children's ratings of confidence in their PM predictions. Confidence was high (maximum possible score=3) regardless of whether children predicted remembering or forgetting. A 2 (PM prediction: will remember vs. will forget) x 2 (PM performance: remembered vs. forgot) ANOVA showed no significant main effects and no interaction, p values>.10. Results for the individual story conditions are not presented given small sample sizes in some cells. Nevertheless, comparison of the two conditions showed that overall confidence did not differ reliably between them (neutral story M=2.70 SD=.64, reminder story M=2.43 SD=.84), $t(44)$=1.19, p=.24.

Discussion

Results of Study 1 showed that children were exceedingly accurate in their PM predictions, with 36 of 46 participants (78%) responding correctly. This was despite the fact that actual PM performance was nowhere near ceiling level (52%) leaving plenty of scope for overestimation. Only 15% of the sample were overly sure of their PM response (i.e., forgetting the task when expecting to remember) with a further 7% being modest about their PM abilities (i.e., remembering the response when expecting to fail). Children were also highly confident in their PM predictions and confidence ratings did not differ significantly as a function of either prediction ('will remember vs. 'will forget') or accuracy (remembered vs. forgot).

Furthermore, there was a trend in predicted direction showing that hearing a reminder story, emphasizing memory issues and the adverse consequences of forgetting, increased PM performance but *only* in children who predicted that they would remember to enact the target response. This finding suggests that the cognitive processes underlying PM performance predictions may have differed between children who predicted success (and were not guessing) and children who predicted failure (and were not guessing). Based on the idea that PM involves future thinking, we speculate that children who predicted success were more likely to think about themselves carrying out the task; that is, imagining the moment of finding the target picture and warning the toy mole not to be afraid – an activity that could have strengthened their intention and increased their sensitivity to incidental reminders in the environment. In contrast, we think it unlikely that children who predicted failure imagined themselves finding the target picture and then forgetting to warn the toy mole – if their pessimistic prediction had involved future thinking then it follows that the reminder story should have jogged their PM just as effectively as it did for children who predicted success. Possibly, children who predicted failing the task instead based their judgment on declarative knowledge regarding PM; that is, they might have remembered their parents or teachers complaining about their own or other people's PM lapses.

The close relation between PM metamemory and PM itself was further highlighted in Study 1 by the observation that prediction accuracy was superior to chance only for children who passed the PM task. Among children who ultimately remembered to enact the PM response, the number who predicted they would remember to do so was much greater than the number who predicted they would forget (ratio 7:1). Among children who ultimately forgot to enact the PM response, the number who predicted failure was similar to the number who predicted success (ratio 2:1). These results suggest that children with superior PM had greater insight into their own PM, as expected if the same cognitive processes (such as future thinking) underlie both optimistic PM performance predictions and actual PM.

Our demonstration of such accurate PM predictions by 5-year-olds might be considered surprising given the extensive literature documenting grossly inflated predictions of RM accuracy in this age group. Accordingly, the primary aim of Study 2 was to replicate and extend the findings of Study 1 by asking a new sample of children to estimate their performance accuracy for *both* PM and RM. The PM task was modelled on that used in Study 1, but this time we presented just the neutral story and manipulated the nature of the PM instructions (specific versus general). Research with adult participants has shown that general instructions elicit lower PM accuracy than specific instructions (e.g., Ellis & Milne, 1996). We therefore wanted to see whether children's accurate PM predictions would extend to a more difficult task for which the target picture was not precisely identified. In addition, the manipulation of instruction specificity enabled us to gauge the depth of insight that 5-year olds have into their PM. If they have well developed declarative metamemory for PM tasks then more children should predict remembering the PM task in the specific- than general instruction condition.

To compare PM and RM prediction accuracy, after completing the PM task, all children were asked to name the pictures again and to predict which pictures they would be able to recall later on. Given that there were 10 pictures in the set, we ensured comparability with the earlier PM prediction task by eliciting judgements on an item-by-item basis; in other words, as each picture was presented, children were asked whether they thought they would later remember or forget it (*cf*. Lipowski et al., 2013). We wanted to compare overall levels of prediction accuracy for PM versus RM across the sample and, moreover, to examine inter-individual differences in memory and memory predictions across the two tasks.

Study 2

Method

Participants

A total of 80 children (40 boys, 40 girls) from three different primary schools took part. All the children were aged between 5 years 2 months and 5 years 6 months (*M* = 5 years 4 months), and spoke English as their primary language. In two schools, the consent (in loco parentis) was granted by headteachers, and in one school by parents. All children also consented themselves on the day of testing. They were randomly assigned to two conditions that varied in terms of the nature of the PM instructions (specific instructions vs. general instructions).

Materials

Materials were the same as for Study 1 except that one of the pictures (a picture of a key) was replaced with a picture of a horse, which was the target picture for the PM task in both conditions, and it was presented in the 7th rather than 6th position in the stack. None of the remaining pictures were of animals. The confidence scale used was also identical to the one in Study 1, but the options were presented in the reverse order, i.e., *‘not sure’, ‘sure’ and ‘very sure’*. The story presented following the PM instructions and prior to the PM task was the neutral story, ‘The Clumsy Alligator’.

Procedure

The procedure was modelled on that used in Study 1, only varying the nature of the PM task instructions. In the case of specific instructions, children were told that Morris was frightened of horses and if they came across a picture of a horse in the stack they had to tell Morris not to be frightened as it was only a picture and not a real horse. In the case of general instructions, children were told that Morris was frightened of animals and if they came across a picture of an animal in the stack they had to tell Morris not to be frightened as it was only a picture and not a real animal. Within each instruction condition half the children were asked, “Do you think you will remember to tell Morris not to be frightened when you see a picture of a horse (animal) or do you think you may forget?” and the remainder were asked, “Do you think you may forget to tell Morris not to be frightened when you see a picture of a horse (animal) or do you think you will remember?” As in Study 1, children were requested to rate their confidence in their PM prediction on a 3-point scale (*1=not sure*, *2=sure*, *3=very sure*).

After finishing the picture naming task and follow-up probing of those children who forgot to carry out the PM task, the researcher introduced the RM task. Specifically, she told the child that they were going to play a simple memory game in which they would be shown each picture from the pile again, one by one, and would have to state whether they thought they would remember it later when asked to recall the pile of cards from their memory. To make it clear that the test would involve recall rather than recognition-memory, children were informed that once all the cards were viewed they would have to "tell" Morris which pictures they had seen. Once the child agreed to do this, the researcher showed them the first picture and asked what it was. After the child named the picture the researcher asked, "Do you think you will remember this picture or do you think you may forget?" After the child made a prediction, the researcher asked the child: "Now, as before, how sure you are that you will remember this picture (or forget, if the child predicted forgetting)?" The child stated his/her confidence on the same 3-point scale (*1=not sure*, *2=sure*, *3=very sure*) that was used earlier for the PM task. This procedure was repeated for the remaining nine pictures. After predictions and ratings were made for all 10 pictures, the researcher asked the child to tell Morris what pictures were on the cards. The child was permitted to recall the pictures in any order, with their responses being recorded by the researcher. Children were then praised for helping Morris in the activity and given a sticker to reward them for taking part.

Results

Out of 80 children, 27 (34%) forgot to enact the PM response when encountering the target in the picture naming task. Post-experimental probing showed that all children succeeded in recalling the PM instructions in response to the first three prompts or recognized the task at the 4th prompt and thus all data were retained for analysis. There was no evidence that children's PM predictions varied as a function of order of questioning (will you remember/forget vs. will you forget/remember), $\chi^2(1, N{=}80){=}0.75$, $p{=}.39$, and so data were pooled across the two orders.

Effects of PM instructions on PM performance and predictions

Of the 40 children who heard specific instructions, 31 remembered the PM task and 9 forgot. Of the children who heard the general instructions, 22 remembered the PM task and 18 forgot. As predicted, the proportion of children who remembered was reliably higher in the specific- than general instruction condition (.78 vs. .55), $z{=}2.18$, $p{=}.030$, 2-tailed. In contrast, the proportions of children who *expected* to remember the PM task in the specific versus general instruction conditions (.78 and .68 respectively) were *not* significantly different from each other, $z{=}1.01$, $p{=}.312$, 2-tailed.

PM predictions and performance

The upper section of Table 3 (panel a) shows the number of children who remembered or forgot the PM response as a function of initial PM prediction (i.e., 'will remember' vs. 'will forget'). Of 58 children who predicted remembering, 43 (74%) did remember the PM task, but of 22 children who predicted forgetting only 10 (45%) remembered the task. The relation between performance predictions and actual performance was significant, $\chi^2(1, N{=}80){=}5.87$, $p{=}.015$ (Phi Coefficient = .27). In line with Study 1, the percentages of children who correctly predicted their PM (69%), underestimated (12%) or overestimated it (19%) were significantly different from the expected percentages had predictions been made at random, $\chi^2(1, N{=}80){=}11.88$, $p{=}.003$.

The middle and lower sections of Table 3 present the results separately for children who heard specific instructions (panel b) and children who heard general instructions (panel c). When considered individually, the relation between PM prediction and PM performance was reliable for general instructions, $\chi^2(1, N=40)=4.57$, $p=.03$ (Phi Coefficient = .34); moreover, the percentages of children who correctly predicted their PM performance (67.5%), and under- (10%) or overestimated it (22.5%) were significantly different from the percentages expected at chance level, $\chi^2(2, N=40)=6.15$, $p=.046$. Although the relation between PM prediction and PM performance was not significant in the specific condition, reflecting the higher levels of performance in that condition, $\chi^2(1, N=40)=0.78$, $p=.38$ (Phi Coefficient = .14), a goodness-of-fit test nevertheless yielded a significant outcome. Applied to the data from the specific condition, for which 28 children (70%) made a correct prediction, 6 children (15%) over-estimated their performance, and 6 children (15%) under-estimated their performance, this test revealed that results were significantly different from the expected results had the children been guessing, $\chi^2(2, N=40)=6.40$, $p=.04$.

Of 53 children who remembered the PM task, there were 43 who predicted that they would be successful (81%) and 10 who wrongly predicted they would fail (19%). These percentages were significantly different from the expected percentages had the children been making predictions at random, $\chi^2(1, N=53)=20.55$, $p<.0001$. Of 27 children who forgot the PM task, there were 12 who predicted that they would fail (44%) and 15 who wrongly expected to pass (56%). These percentages were not reliably different from predictions made at random, $\chi^2(1, N=27)=0.33$, $p=.56$. The proportion of children who correctly forecast PM success was reliably higher than the proportion of children who correctly forecast PM failure (.81 vs. .44), $z=3.37$, $p<.001$, 2-tailed.

PM confidence ratings

Table 4 shows means (and standard deviations) of confidence ratings for the PM predictions. A 2 (PM prediction: will remember vs. will forget) x 2 (PM performance: remembered vs. forgot) ANOVA showed that children who predicted 'will remember' were more confident in their judgements than children who predicted 'will forget', $F(1,76)=5.34$, $p=.02$. However, there was no significant main effect of PM performance and no interaction, p values>.10. Comparison of the two PM instruction conditions showed that overall confidence did not differ reliably between them (specific instructions $M=2.65$ $SD=.66$, general instructions $M=2.63$ $SD=.63$), $t(78)=0.17$, $p=.86$. Similarly, confidence ratings were equivalent when considering only the children who predicted remembering (specific instructions $M=2.77$ $SD=.50$, general instructions $M=2.70$ $SD=.61$), $t(56)=0.49$, $p=.63$, or only the children who predicted forgetting (specific instructions $M=2.22$ $SD=.97$, general instructions $M=2.46$ $SD=.66$), $t(20)=-0.69$, $p=.50$.

RM predictions and performance

Of 80 children, there were 61 (76%) who expected to remember all 10 pictures, 11 (14%) who expected to remember 9 pictures, 5 (6%) who expected to remember 8 pictures, and 3 (4%) who expected to remember 7 pictures. The mean number of pictures that children predicted they would recall in total ($M=9.63$ $SD=.77$) was significantly higher than the mean number of pictures that they actually recalled ($M=4.64$ $SD=1.18$), $t(79)=4.99$, $p<.001$, $\eta_p^2=.93$.

Examining the data on an item-by-item basis showed that in the case of the first picture to be presented, 79 of 80 children predicted that they would be able to recall it whereas only 29 went on to recall it. For the remaining pictures, the number of children predicting success ranged between 73 and 79 whereas the number of children who achieved success ranged between 25 and 68. To gain a better understanding of differences between PM and RM prediction accuracies, Table 5 shows the number and percentages of children (out of 80) who predicted their performance correctly versus incorrectly (over- or underestimated it) for the PM task and for each of the 10 RM items. Goodness-of-fit tests for the RM items showed that results were significantly different from chance (all p values$<.0001$) reflecting the high percentages of children who overestimated their performance (from 44% to 64%, compared to the chance level of 25%). The percentage of children who correctly predicted their RM was reliably better than chance (50%) only for items 7 (horse; recalled by 68 children) and item 8 (tractor; recalled by 53 children). Such high RM prediction accuracy for the horse picture is unsurprising given that it was the target of the PM task.

Mean RM confidence across the set was high (M=2.55 SD=.41) and ranged between 2.41 and 2.68 (with the highest rating being for the picture of the horse). RM confidence ratings failed to differ significantly between children who were allocated to the specific- versus general instructions PM conditions (M=2.57 vs. M=2.53, respectively), $t(78)=0.41$, $p=.68$.

Relations between PM and RM

RM predictions, RM confidence ratings and RM performance were each examined as a function of PM using a 2 (PM prediction: will remember vs. will forget) x 2 (PM performance: remembered vs. forgot) ANOVA. There were no significant main effects or interaction when considering either RM prediction or RM performance, all p values$>.10$. In the case of RM confidence ratings, there was a reliable effect of PM prediction indicating that children who expected to remember the PM task gave higher

RM confidence ratings than children who expected to forget the PM task (*M*=2.63 *SD*=.35 vs. *M*=2.33 *SD*=.48), $F(1,76)=7.05$, $p=.01$, $\eta_p^2=.09$.

Discussion

Like the previous experiment, Study 2 found that children were generally accurate and confident in their PM predictions with most (69%) correctly anticipating whether they would pass or fail and relatively few (19%) expecting to execute the intended action but ultimately forgetting to do so. As hypothesized, children's PM was better when they were instructed to respond to a specific cue (i.e., horse) rather than a general cue (i.e., animal) but PM prediction accuracy was superior to chance in both groups. Results for the general instructions condition are important in showing that many children could correctly anticipate their ability to respond to a PM target that was not identified explicitly beforehand. Nevertheless, the fact that children's predictions did not reliably distinguish the difficulty levels of specific- versus general instructions indicates scope for developmental improvement in their declarative PM metamemory.

Results also replicated Study 1 in showing that PM prediction accuracy was superior to chance only for children who remembered the PM response, a pattern evident for both the specific- and general instruction conditions. Among children who passed the PM test, the ratio of predicting success versus predicting failure was 4:1. Among children who failed the PM test, the ratio of predicting failure versus predicting success was 3:5. These findings reinforce the earlier conclusion that children's insight into their own PM capabilities was greater if their PM performance was good rather than poor.

Notably, and in striking contrast to PM predictions, the vast majority of children over-estimated their ability to freely recall the pictures presented to the mole. Using an item-by-item method of eliciting RM predictions, children foretold an average recall accuracy of 96% whereas they achieved a mean accuracy of 46%. Indeed, children almost never anticipated that they would forget to recall a picture, with only 19 children judging that their performance would be less than perfect (or a total of 30 predicted failures out of 800 predictions). Over-estimation of RM was apparent from the first picture (with 79 of 80 children predicting that they would be able to remember it) and remained high across the set (never dropping below a total of 73 'will remember' predictions). RM prediction accuracy was superior to chance for only 2 of 10 pictures, with one of these being the PM target. Children also reported high levels of confidence in their RM predictions.

Taken together, these results replicate and extend previous research on RM prediction accuracy in young children (Lipko et al., 2009, 2012; Shin et al., 2007), especially the studies that have used item-by-item predictions and assessed judgements of learning in cued recall tasks. Thus, in the study by Lipowski et al. (2013, Experiment 1), 83% of 5-year old children predicted incorrectly that they would recall the names of *all* the 12 toy animals presented to them. Likewise, Schneider, Visé, Lockl and Nelson (2000), who compared item-by-item and aggregate prediction accuracy using a similar paradigm, found that when making immediate item-by-item predictions, 8-year old children on average predicted recalling 20 items out of 24 (83%) when they actually recalled only 11 items (46%).

The observation of such discrepant PM and RM prediction accuracy in the present study suggests that 5-year old children have better insight into PM than RM. However, this conclusion is weakened by the fact that different methods were used to compare PM versus RM predictions. Even though children made item-by-item RM predictions, there were 10 items in the RM task and only one target item in the event-based PM task. To address this issue, Study 3 aimed to see whether RM prediction accuracy would improve given a procedure that better matched the PM task, specifically, by asking a new group of children to judge their ability to recall the mole's surname. In accordance with the PM procedure, then, participants were requested to make a prediction regarding subsequent memory performance for a single piece of information before hearing the neutral story and completing the picture-naming activity. Half the children heard a surname based on a familiar word (Mr. Rainbow) and the remainder heard a surname based on an unfamiliar word (Mr. Tainbow). We expected that the unfamiliar surname would be much harder to recall and we included this condition in case of ceiling effects in relation to children's recall of the familiar surname.

Study 3

Method

Participants

Thirty-five typically developing children (14 girls, 21 boys) were recruited from local primary schools following informed parental- and own consent. Their ages ranged from 5 years 3 months to 5 years 8 months (*M* = 5 years 6 months). Participants were randomly assigned to either the 'Rainbow' or 'Tainbow' conditions (n=18 and n=17, respectively).

Materials and procedure

Materials and procedure were identical to Study 1 except that children were initially introduced to the mole without being told his name. In addition, just before reading 'The Clumsy Alligator' story, the researcher gave them a single-item RM prediction task instead of the PM instructions. Specifically, half the children were informed that the mole's name was Mr. Rainbow and the remainder were informed that his name was Mr. Tainbow. Children were asked to repeat the surname to ensure that they heard it correctly. They were then asked whether they thought they would be able to remember his name later on. To make it clear that they were being queried about recall rather than recognition-memory, the researcher explained that she would later ask them to "tell" her the mole's name. After recording each child's prediction the researcher asked him or her to indicate on a 3-point scale (*3=very sure, 2=sure, 1=not sure*) how confident they were in their judgement. Following the researcher's narration of the story, the picture naming task commenced. Upon the appearance of the picture of a tractor (which occurred in the 6th position), the researcher stopped the children and asked them to recall the mole's name. Participants were allowed up to 60 seconds to recall the name, after which time the researcher told them what it was. After finishing their verbal labelling of the remaining four pictures in the stack, children were thanked and returned to their class.

Results

All 18 children in the Rainbow condition and all 17 children in the Tainbow condition predicted that they would remember the mole's surname. In addition, the mean confidence ratings in these predictions were high in both groups (M=2.44, SD=.92 and M=2.17, SD=1.03, respectively) and did not differ reliably (F<1). In contrast, the groups differed markedly in terms of actual performance. While 17 of 18 children (94%) in the Rainbow condition correctly remembered the mole's surname, none of the children in the

Tainbow condition (0%) were able to remember it, $\chi^2(1, N=35)=31.22$, $p<.0001$. All children in the latter condition reported that they could not remember the surname rather than recalling the surname incorrectly.

Discussion

Study 3 found that children substantially over-estimated their ability to remember the unfamiliar surname of the toy mole. Every one of the participants in the unfamiliar surname condition predicted, and was confident in predicting, that they would remember the name 'Mr Tainbow' but all proceeded to forget it when tested later on. Results of this condition thus confirmed those of Study 2 in showing exceedingly poor RM prediction capabilities. Although participants in the familiar surname condition were 100% accurate in their RM predictions, it is impossible to know whether this result is meaningful given that actual performance was errorless. Nevertheless, results of the familiar surname condition are consistent with those of the unfamiliar surname condition, and of Study 2, in showing that 5-year old children are highly likely to predict successful recall irrespective of what they are being asked to recall.

General Discussion

To our knowledge, the present investigation is the first to have explored young children's metamemory awareness for PM as gauged by their ability to predict their own PM performance. Results showed prediction accuracy to be very good with most participants (around 70%) judging correctly whether they would remember to act on their intention to warn a toy mole not to be afraid when the target picture was uncovered (Studies 1 and 2). These results contrasted markedly with the findings for two RM procedures where children greatly overestimated their memory recall. This was true whether children performed item-by-item RM prediction for 10 studied pictures (Study 2) or tried to estimate their recall accuracy for the mole's surname (Study 3).

Superior prediction accuracy for PM relative to RM cannot easily be explained in terms of motivational or experiential factors. In previous research on RM metamemory, reports of over-confident predictions by young children have been taken to mean that such behavior serves an adaptive function, specifically, by encouraging persistence on memory tasks (Dunlosky & Metcalfe, 2009). From this perspective, though, it is unclear why PM predictions were not similarly inflated relative to actual performance. Likewise, it seems improbable that the effect was due to children's greater familiarity with PM tasks. Winograd (1988) suggested that children often receive simple PM requests at home (e.g., to deliver messages or carry out chores) whereas they rarely encounter RM requests until formal schooling commences. Given anecdotal evidence that parents perceive their children's PM lapses as more problematic than RM errors (Meacham, 1977), it could thus be surmised that the development of PM metamemory skills benefits from frequent feedback. However, our findings indicated that PM prediction accuracy varied according to actual PM performance – specifically, Studies 1 and 2 showed that children who passed the PM task made more accurate predictions than children who failed the PM task. If corrective feedback is important to the development of children's memory prediction skills then it follows that children with poor PM should be more aware of their shortcomings in this domain than children with good PM are aware of their strengths.

Alternatively, it could be argued that PM and RM are distinct forms of memory. This was the conclusion reached by Kvavilashvili et al. (2001) following a comparison of PM and RM capabilities in children aged 4- to 7 years. They found that age explained only half the variance in PM (7%) compared to RM (15%); moreover, there was no significant relationship between the two. In Study 2 of the present investigation it was similarly shown that RM performance failed to differ reliably between children who passed the PM test and children who failed – thus, our results indicated that PM and RM were functioning independently in this young age group (for similar findings, see Guajardo & Best, 2000). If PM constitutes a unique form of memory that matures earlier than RM, then associated metamemory skills might likewise develop more rapidly (Kvavilashvili et al., 2008). This would accord with evidence that children acquire declarative knowledge regarding PM at a younger age than they acquire declarative knowledge regarding RM (Beal, 1985; Kreutzer et al., 1975).

On the other hand, it might be premature to conclude that young children will *always* show superior prediction accuracy for PM compared to RM. Some studies have found that children's RM prediction accuracy improves when predictions are solicited after a short delay, a phenomenon attributed to the fact that delayed judgements are more likely to draw on long- rather than short-term memory (e.g., Schneider et al., 2000). For example, Lipowski et al. (2013) reported that the percentage of 4- and 5-year-old children who predicted recalling all the studied items when questioned immediately (83%) dropped to 48% in the delayed judgement of learning condition in which children had to attempt to recall the toys' names after two minutes from hearing the names and then provide their recall predictions. These findings raise the possibility that our own participants could have performed to a much higher level on the RM prediction tasks had we not asked them to make their predictions straight away.

Rather than simply comparing the accuracy of PM versus RM predictions, a more informative approach in future research might be to explore the cognitive mechanisms underlying them. Interestingly, despite finding that children's delayed judgements of learning were accurate on average, Lipowski et al. (2013) noted that such judgements were not significantly correlated with actual recall. Their findings therefore suggested that for young children the processes involved in RM predictions are largely unrelated to those driving RM performance. These results are in striking contrast to those observed for PM in the present investigation, which were notable in revealing a robust association between PM predictions and PM performance that was apparent in four individual conditions across the first two studies. Regardless of what conclusions might eventually be drawn regarding RM, we believe that the present findings are important in implicating a strong involvement of self-reflective awareness in successful PM in young children. Studies 1 and 2 consistently demonstrated that children who remembered to enact their PM intention were likely to predict they would succeed on the task (with a success rate over 80%) whereas children who forgot to enact their PM intention had little idea whether they would succeed or fail (with a success rate not superior to chance). Additionally, Study 1 found that presenting a reminder story that highlighted memory issues tended to boost PM performance in children who predicted that they would remember to enact their intention but made no difference to the PM performance of children who thought they would forget to enact their intention. These two sets of findings converge on the conclusion that the cognitive processes involved in *optimistic* PM performance predictions were also integral to PM itself.

As suggested earlier, one possible candidate for a self-reflective process underlying predictions of PM success *and* actual PM is future thinking. It has been postulated that people encode PM intentions more efficiently if they mentally self-project into a future time and place appropriate to the intended response, probably because the act of imaginative pre-experiencing the PM cues increases their salience (Brewer & Marsh, 2010). Buckner and Carroll (2007) defined self-projection as "the ability to shift perspective from the immediate present to alternative perspectives" (p. 49), and they reviewed evidence that it relies heavily on brain regions involved in episodic memory and theory of mind, especially medial temporal-parietal lobe regions. In line with these ideas, Ford et al. (2012) observed that 4- to 5-year-old children's performance on two different measures of event-based PM was related to their ability to reason about false belief, even after controlling for age, verbal intelligence, working memory, and inhibitory skills. Notably, false-belief understanding and inhibitory skills appeared to tap different aspects of PM; whereas inhibition predicted PM only when children needed to suspend their activity on the ongoing task, theory of mind predicted PM irrespective of whether the ongoing task needed to be interrupted. Based on these findings, Ford et al. postulated that the false-belief tests captured individual differences in how effectively children formed their intention in the first place based on their propensity for future thinking.

Given evidence that the capacity for future thinking develops rapidly between the ages of 3- and 6 years it would not be surprising if it constitutes an important source of individual differences in young children's PM (Atance & Jackson, 2009; Ford et al., 2012). In light of the present results, we suggest that future thinking also plays an important role in children's predictions of future success in PM tasks – essentially, a child's act of imagining themselves carrying out the task as planned should bolster not only the chances of their actually doing it but subjective confidence in their ability to do it. In contrast, performance predictions regarding RM might rely much more heavily on declarative knowledge than any imaginative pre-experiencing of memory retrieval.

Conclusions

In conclusion, the present investigation yielded important preliminary evidence that 5-year-old children are very good at predicting how well they will do on PM tests. It was additionally shown that (1) PM prediction accuracy was higher among children who remembered the PM task than among children who forgot it (Studies 1 & 2), and (2) encouraging children to reflect on memory processes by exposing them to a reminder story was likely to benefit their PM only when they had made an optimistic PM prediction (Study 1). As discussed, one explanation of these findings is that the kinds of self-reflective processes involved in performance predictions are also inherent to setting up PM intentions, specifically, by supporting self-projection into the future. Follow-up studies could explore this possibility by directly examining the relations between future thinking (and other forms of self-projection) and PM procedural metamemory.

Additionally, future research could address potential practical applications of asking children to predict their PM. It is well-documented that performance predictions enhance RM in adults and a recent study by Meier, von Wartburg, Matter, Rothen, and Reber (2011) found the same to be true of PM. These researchers suggested that performance predictions either increase participants' commitment to the PM response or raise the activation of their plan to make it more accessible. Both ideas are compatible with the idea that forming a PM intention involves future thinking and suggest that it would be fruitful in future investigations to compare PM accuracy between children who either do or do not make prior performance predictions.

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Table 1

Number (Percentages) of Children in Study 1 who Remembered or Forgot the Prospective Memory Task as a Function of Prospective Memory Prediction

(a) Whole group (*n*=46)

	PM Performance		
PM Prediction	Remembered	Forgot	Total
Will Remember	21 (75%)	7 (25%)	28 (100%)
Will Forget	3 (17%)	15 (83%)	18 (100%)
Total	24 (52%)	22 (48%)	46 (100%)

(b) Neutral story condition (*n*=23)

	PM Performance		
PM prediction	Remembered	Forgot	Total
Will Remember	7 (58%)	5 (42%)	12 (100%)
Will Forget	2 (18%)	9 (82%)	11 (100%)
Total	9 (39%)	14 (61%)	23 (100%)

(c) Reminder story condition (*n*=23)

	PM Performance		
PM Prediction	Remembered	Forgot	Total
Will Remember	14 (87.5%)	2 (12.5%)	16 (100%)
Will Forget	1 (14%)	6 (86%)	7 (100%)
Total	15 (65%)	8 (35%)	23 (100%)

Table 2

Means (and Standard Deviations) of Confidence Ratings of Children in Study 1 who Remembered or Forgot the Prospective Memory Task as a Function of Prospective Memory Prediction

Whole group (*n*=46)

	PM Performance		
PM Prediction	Remembered	Forgot	Total
Will Remember	2.67 (.66)	2.57 (.79)	2.64 (.68)
Will Forget	2.33 (1.16)	2.47 (.83)	2.44 (.86)
Total	2.63 (.71)	2.50 (.80)	2.57 (.75)

Table 3

Number (Percentages) of Children in Study 2 who Remembered or Forgot the Prospective Memory Task as a Function of Prospective Memory Prediction

(a) Whole group (*n*=80)

	PM Performance		
PM Prediction	Remembered	Forgot	Total
Will Remember	43 (74%)	15 (26%)	58 (100%)
Will Forget	10 (45%)	12 (55%)	22 (100%)
Total	53 (66%)	27 (34%)	80 (100%)

(b) Specific instructions condition (*n*=40)

	PM Performance		
PM prediction	Remembered	Forgot	Total
Will Remember	25 (81%)	6 (19%)	31 (100%)
Will Forget	6 (67%)	3 (33%)	9 (100%)
Total	31 (77.5)	9 (22.5%)	40 (100%)

(c) General instructions condition (*n*=40)

	PM Performance		
PM Prediction	Remembered	Forgot	Total
Will Remember	18 (67%)	9 (33%)	27 (100%)
Will Forget	4 (31%)	9 (69%)	13 (100%)
Total	22 (55%)	18 (45%)	40 (100%)

Table 4

Means (and Standard Deviations) of Confidence Ratings of Children in Study 3 who Remembered or Forgot the Prospective Memory Task as a Function of Prospective Memory Prediction

Whole group (*n*=80)

	PM Performance		
PM Prediction	Remembered	Forgot	Total
Will Remember	2.74 (.54)	2.73 (.59)	2.74 (.55)
Will Forget	2.30 (.82)	2.42 (.79)	2.36 (.79)
Total	2.66 (.62)	2.59 (.69)	2.64 (.64)

Table 5

Number (Percentages) of Children as a Function of Type of Prediction (Correct vs. Overestimation vs. Underestimation) for the Prospective Memory Task and Retrospective Memory Items

	Type of Prediction			
Item type	Correct	Overestimation	Underestimation	Total
PM task	55 (69%)	15 (19%)	10 (12%)	80 (100%)
RM – Item 1	30 (37.5%)	50 (62.5%)	0 (0%)	80 (100%)
RM – Item 2	29 (36%)	49 (61%)	2 (3%)	80 (100%)
RM – Item 3	29 (36%)	51 (64%)	0 (0%)	80 (100%)
RM – Item 4	29 (36%)	51 (64%)	0 (0%)	80 (100%)
RM – Item 5	27 (34%)	51 (64%)	2 (2%)	80 (100%)
RM – Item 6	33 (41%)	47 (59%)	0 (0%)	80 (100%)
RM – Item 7	67 (84%)	12 (15%)	1 (1%)	80 (100%)
RM – Item 8	54 (67%)	23 (29%)	3 (4%)	80 (100%)
RM – Item 9	42 (52%)	35 (44%)	3 (4%)	80 (100%)
RM – Item 10	37 (46%)	42 (53%)	1 (1%)	80 (100%)

Note. The number (percentages) of children who would be expected by chance to make correct predictions, or over- versus underestimate their performance, was 40 (50%), 20 (25%) and 20 (25%) respectively.

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